EURASIAN JOURNAL OF ACADEMIC RESEARCH
Innovative Academy Research Support Center
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DEVELOPMENT OF A METHOD FOR ASSESSING THE EFFICIENCY OF THE POWER SUPPLY SYSTEM OF INDUSTRIAL ENTERPRISES

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https://doi.org/10.5281/zenodo.4904067

ARTICLE INFO

Received: 20th May 2021
Accepted: 25th May 2021
Online: 30th May 2021

KEY WORDS

energy efficiency, power supply system, multicriteria analysis, standardization of indicators, generalized indicator, normalization of indicators

ABSTRACT

The article describes the methodology for calculating the efficiency factor of the power supply of the enterprise based on the indicators of power consumption obtained from the system of technical metering of electricity. The developed program can be used for energy inspections of an enterprise to assess the efficiency of the enterprise's power supply system.

As you know, the most important potential for saving electricity is concentrated in industry, as the main consumer of energy. Increasing production efficiency requires reducing production costs, a comprehensive study of all their components and identifying sources of unjustifiably high costs. The main direction in solving this problem is energy saving in production, improving the management of energy consumption of the enterprise [1]. To search for reserves of economic growth and mobilize the management potential of an enterprise, it is necessary to use a reasonable system of indicators, which would allow an objective assessment of the efficiency of the enterprise as a whole, as well as certain types of production resources used [2].

A number of Russian scientists such as M.V. Zhurkin, A.A. Ermilov, N.R. Voltovskaya, V.N. Dubinin and others are engaged in the development of methods for assessing the energy efficiency of the power supply system of industrial enterprises. Advanced scientific developments in the field of analyzing the level of efficiency of the power supply system of an enterprise are observed in the works of the Uzbek scientist N.N. Sadullaev. The disadvantage of existing methods is the problem of assigning weight coefficients

The power supply system of an enterprise should be considered as a transmission link from the point of connection to the power system to consumers. Improving the energy efficiency of industrial enterprises is a complex and complex task. We offer a new developed generalized coefficient for assessing the efficiency of the power supply system, which will consist of four generalized coefficients:

1. Energy coefficient - an indicator characterizing the ability of the power supply system of an enterprise to transmit the required amount of electricity with a minimum of losses;

2. Quality factor - an indicator characterizing the capabilities of the power supply system of an electricity transmission enterprise of proper quality;

3. Reservation coefficient is an indicator characterizing the level of reservation of the elements of the enterprise's power supply system (transformers, cable lines, etc.).

4. Automation coefficient - an indicator characterizing the level of automation of the power supply system of an industrial enterprise.

All indicators are normalized to dimensionless values. To date, a huge number of relative normalization schemes have been developed. Most of them are based on maintaining the ideal values of the criteria Fu = (f1u, ···, fju, ··· kfnu), with the help of which the vector is reduced to a dimensionless form:

$$E = (e_1^н,..., e_j^н,..., e_n^н) = (\frac{f_1}{f_1^u},\cdots,\frac{f_2}{f_j^u},\cdots,\frac{f_n}{f_n^u}). \quad (1)$$

Where: eun- is the relative value of the n-indicator reduced to its ideal value; fn- is the effective value of the indicator; f1u - ideal value of the indicator [3].

The energy coefficient is determined by multiplying the given energy indicators of electricity consumption:

$$K_{эн} = К'_{\eta} \cdot К'_{\phi} \quad (2)$$

Where: K'_{η} – reduced efficiency of the power supply system during the transmission of electricity,

K'_{φ} - power coefficient.

The generalized quality factor at the output of the enterprise's power supply system is determined by the following formula:

$$K_{кач} = \prod_{n=1}^{n} K_n = K_1 \cdot K_2 \cdots K_n = K_{\sin} \cdot K_{\Delta U} \cdot K_{сим} \quad (3)$$

Where: K_{sin} – non-sinusoidal coefficient, $K_{\Delta U}$- voltage deviation coefficient, $K_{сим}$ - voltage asymmetry coefficient, determined depending on the current voltage value on the buses of the power supply system.

Accordingly, the coefficient of redundancy of the elements of the power supply system of the enterprise is determined by the following formula:

$$K_{рез} = \frac{N_р}{N_{общ}} = \frac{N_р}{N_р + N_{нр}}, \quad (4)$$

Where: $N_р$ – the number of redundant elements of the power supply system that can be disconnected without interrupting the power supply to consumers; $N_{общ}$ – the total number of elements according to the power supply scheme of the enterprise; $N_{нр}$– the number of non-redundant elements of the power supply system, the disconnection of which leads to an interruption in the power supply to consumers.

The automation factor is determined by the following formula:

$$K_{ав} = \frac{N_{\Delta q} + N_{\Delta u} + N_{авр}}{3 \cdot N_{пс}}, \quad (5)$$

Where: $N_{авр}$ – the number of substations with automatic transfer switches;

$N_{\Delta U}$ – the number of substations with automatic voltage regulation devices; $N_{\Delta q}$ – number of substations with automatic control devices cosφ; $N_{пс}$– the total number of substations in the enterprise.

The indicator of the efficiency of the enterprise's power supply system (Kee) is proposed to be determined by the following formula:

$$Кээ = Кэ \cdot Кк \cdot Кр \cdot Ка \quad (6)$$

Where: Кэ- energy coefficient, Кк- quality factor, Кр-coefficient of reservation, Ка-coefficient of automation of the power supply system, Ка-coefficient of efficiency of the power supply system of the enterprise.

According to [1] and [2], in general-purpose power supply systems, 3 groups of enterprises can be distinguished according to the energy efficiency of the power supply system. These are group A- (0.86-1), group B (0.74-0.85) and group C (0-0.73).

Enterprises that fall into group A need to be stimulated, and enterprises that fall into group C should be recommended to conduct an energy survey of the enterprise's power supply system. For the automated calculation of the indicator, a computer program "Evaluation of the efficiency of the power supply system of an enterprise" based on Delphi has been developed.

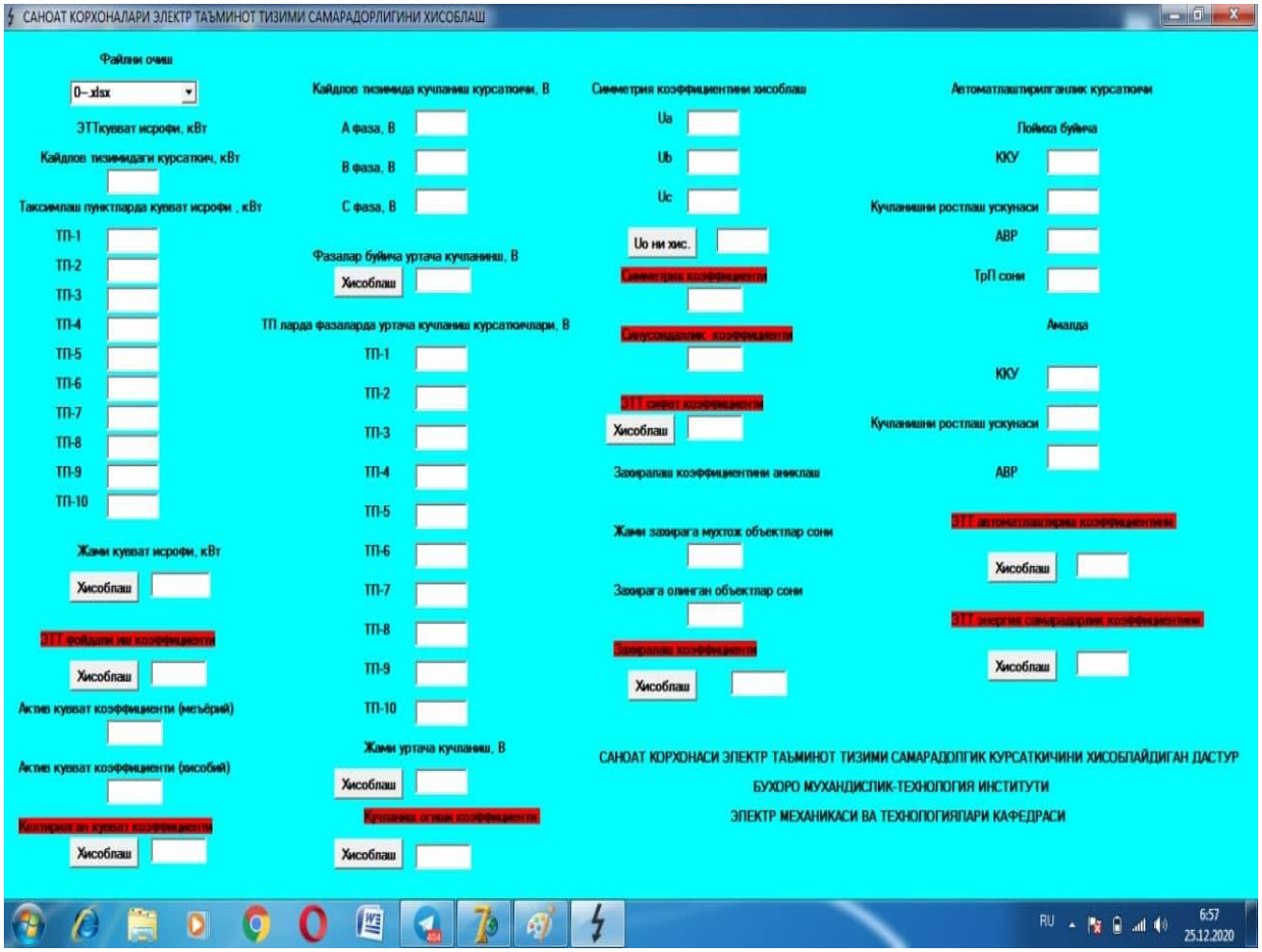

Fig. 1. Screenshot of the program “Evaluation of the efficiency of the power supply system of the enterprise”.

The program automatically reads the indicators from commercial electricity meters, the rest of the indicators are entered manually after an express analysis of the enterprise documentation.

The developed methodology was used during an energy survey of an industrial enterprise LLC Evrosnar in the Jondor region of the Bukhara region to identify the reserve of energy savings. EVROSNAR Ltd. is a press and extraction oil company. The main types of products manufactured by this enterprise are: refined oil (final product); black oil (intermediate product. In terms of technological equipment, the enterprise operates around the clock. The enterprise is supplied with electricity from the Zhondor substation by

two overhead lines through feeders. There are two transformers TP, one of them is backup: 1-transformer - TM-1600 kVA, is functioning at this time; 2-transformer - TM-1000 kVA, standby. The transformer substation has 2 sets of stationary reactive power compensator for 700 and 500 kVAr. Power

The results are shown in Table-1.

Coefficient	$K_{эн}$	$K_{кач}$	$K_{р}$	$K_{ав}$	$K_{ээ}$
During EA	0,8	0,93	0,97	0,95	0,68
After ESM	0,97	0,96	1	1	0,93
The change %	+17	+3	+3	+5	+25

Table 1. Values of changes in the efficiency coefficients of the power supply system at the enterprises of Evrosnar LLC before and after the implementation of measures to improve the energy efficiency of the power supply system.

As can be seen from the table, this technique allows a deeper analysis of the possibilities of energy saving and the potential for increasing the energy efficiency of the enterprise. Based on the analysis data according to the developed methodology, it was possible to develop 24 measures to improve the energy efficiency of the enterprise and increase the efficiency ratio by 25%.

Conclusion

The developed technique allows:

1.The developed methodology allows, on the basis of a comprehensive analysis of energy efficiency indicators, to identify energy saving reserves.

2. Allows you to make a rating on the energy efficiency of the power supply system of industrial enterprises

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